RHODE ISLAND
DEPARTMENT OF FORESTRY.

How to Cut Woodlots.

BY

JESSE B. MOWRY
Commissioner of Forestry.

PROVIDENCE, R. I.
E. L. FREEMAN COMPANY, STATE PRINTERS.
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FIG. 1.
Old style of felling.
John Jep and Stout Emons after heart of white oak.

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FOREWORD.

This writing appears as Part II of a pamphlet, entitled *Warden and Woodsman*, published by this department. For further studies in the silvicultural systems of cutting and reproducing forests, consult Graves' "Principles of Handling Woodlands," Hawley and Hawes' "Forestry in New England," and the writings of Spring, Chapman, Rane, and others.

THE AUTHOR.

Chepachet, November, 1913.

Fig. 2.
Portable steam sawmill.

HOW TO CUT WOODLOTS.

Preliminary.

The underlying principle of forestry is a succession of forest products. Forestry aims to utilize the mature timber with economy and profit to the present owner, and at the same time provide for the rapid renewal of growth on the cut-over land. Forestry, therefore, has two distinct sides: the growing of timber, or silviculture; the cutting of grown timber and the manufacture and sale of lumber, or lumbering.

Hitherto, lumbering in Rhode Island has consisted in removing the timber by the method of clearing in one cutting, without much thought or provision for the future forest. Until recently, the magnificent American forests appeared so boundless in extent and the lumber supply so inexhaustible, that nobody paid any attention to forest fires, much less to waste in lumbering. But with the gradual diffusion of knowledge, the scarcity of old growth, and the rise in stumpage, the time has come when owners will not permit their woodlands to be cut over in a crude manner, but will insist upon the practice of conservative lumbering. We are all disposed to live for the present, and the lumberman is no exception to the rule; he naturally wants to pocket the most money in the shortest time from timber ready to be cut, rather than to embark in the forestry business, involving as it does, risks, uncertainties, and a long period of time. That forestry on a large scale is properly the work of states, municipalities, and corporations which exist for generations, can hardly be denied. There are, however, certain branches of forestry which fall within the scope of private enterprise. Protection, utiliza-

tion, reduction of waste, disposal of slash, stimulation of the annual increment, and cutting to a diameter limit under certain conditions, are all measures which *pay in the present.*

One of the worst drawbacks to forestry is the lack of skilled labor at moderate prices. Years ago the woodsmen were willing to live on a fare of pork and beans, potatoes, white bread, johnny cake, coffee and molasses, served in tin dishes. They were a rugged hearty set of men ready for hard work and satisfied with their food and pay. Today the same class of labor sometimes demand short hours, big wages, and the best table board. Again, forestry is a new thing; people do not yet understand it; perhaps some of the farmers, lumber merchants and sawmill men are inclined to regard it as something impractical, expensive and visionary. Many lumbermen who are skilled enough in such routine matters as the set-up of portable mills, the running of a circular saw and the scaling of lumber have given little or no study to lumbering in its larger aspects, such as the grading of lumber, the standard dimension requirements, the many uses of different species of wood, the demands of wood-using industries for the different kinds of lumber, the estimation of standing timber, and the reproduction and protection of the forest.

Despite all these drawbacks the lumbermen have usually managed to make good profits in the business, and they have done so largely through the rise in price of lumber and the failure of timber owners to be alive to the value of their woodlots.

The department of forestry has not urged the passage of laws relating to the preservation of seed trees, the use of spark arresters on sawmills, and the disposal of slash, because it is thought to be better for the forest owners and lumbermen themselves, as they gradually come to see their own interests in these matters in a clearer light to handle them voluntarily without statutory requirements. Forestry has come to stay with us, and the sooner this fact is appreciated the better for all concerned. With every passing decade, the methods of practical forestry will become more and more intensive. This department offers to assist owners and lumbermen in

FIG. 3.
Simple Coppice Method. R. I.

Fig. 4.
Coppice with Reserves. R. I.

matters pertaining to reforestation, protection and the cutting of woodlots, and the State has the right to require the conservation of its forests.

Methods of cutting and reproducing stands are here outlined. It is hoped that these methods which are applicable to the local forests may be adopted and practiced throughout the State.

SIMPLE COPPICE.

This is a very useful method of silviculture and the simplest and easiest to apply. It is applicable to stands of mixed hardwoods and swamps of red maple which sprout vigorously in localities near cities where the price of cordwood, fence posts and other small material is high.

Let us suppose a farmer wants to manage his 180-acre woodlot for the steady production of cordwood on a rotation of 30 years. He divides the tract into 30 lots of about equal productive capacity and cuts one lot clear every year. The sprouts which follow this cutting are even aged, and at the end of 30 years when the whole stand is cut over, he has a series of 30 lots of sprouts ranging in age from 1 to 30 years. Every year the sprouts of one 6-acre lot are 30 years old and ready for cutting.

Successful application of this system requires clear cutting on a rotation of 20 to 40 years when the stumps are at the age of maximum sprouting capacity. A supply of young seedlings among the sprouts to take the place of any exhausted stumps is provided for by natural reproduction or by planting. The wood should be cut in autumn or winter and promptly removed from the lot, the brush utilized for kindlings or otherwise disposed of in a way to do least injury to the sprout growth.

COPPICE WITH RESERVES.

Suppose there are on the above named woodlot straight, thrifty white oaks scattered over the area, which would yield much larger

returns if allowed to reach timber size and which the owner desires for lumber. In this case he leaves standing through two or three rotations, a certain number on each acre, perhaps 20 or 30, the number depending upon whether the coppice is composed of light-demanding trees like chestnut and oak, or shade-enduring trees like maple and beech. In no case should the number of reserves be so large that their shade would much retard the growth of the coppice. Such of these oak reserves as survive the increased exposure to wind following the sudden removal of the surrounding trees, are then cut for lumber at the time of removal of the coppice for cordwood. The loss in yield of coppice is probably more than counterbalanced by the value of the white oak timber.

POLE-WOOD COPPICE.

In western Rhode Island the farmers' woodlots of mixed hardwoods are usually cut clear on a rotation of 50 to 80 years, according to when a sale can be made. The larger trees are used for lumber, ties and poles; the small trees and tops for firewood.

Chestnut sprouts fairly well in old age. But good reproduction from old stumps of oak cannot be relied upon; some stumps sprout well, some send up weak shoots and others fail to sprout at all. Owing to the density of the stand or to forest fire, there may be few or no seedlings on the ground at the time the lot is cut; the succeeding stand, therefore, depending as it does upon such stumps as may retain their sprouting capacity, is apt to be inferior to the previous one in quality and yield. Continuation of this treatment means a gradual deterioration of the woodlot.

Such woodlands may be reclaimed by the pole-wood coppice method which aims to produce this class of timber partly by sprouts and partly by seed. The stand when 50 to 80 years old is removed in two cuttings, 5 to 10 years apart. The first is called a reproduction cutting or a seed cutting in which about 30 per cent. of the volume of wood is removed. This cutting takes out the defective and suppressed trees and those of undesirable species. As soon as this seed

FIG. 5.
Pole-Wood Coppice Method Applied to Oak-Chestnut Stand, Smithfield, R. I.

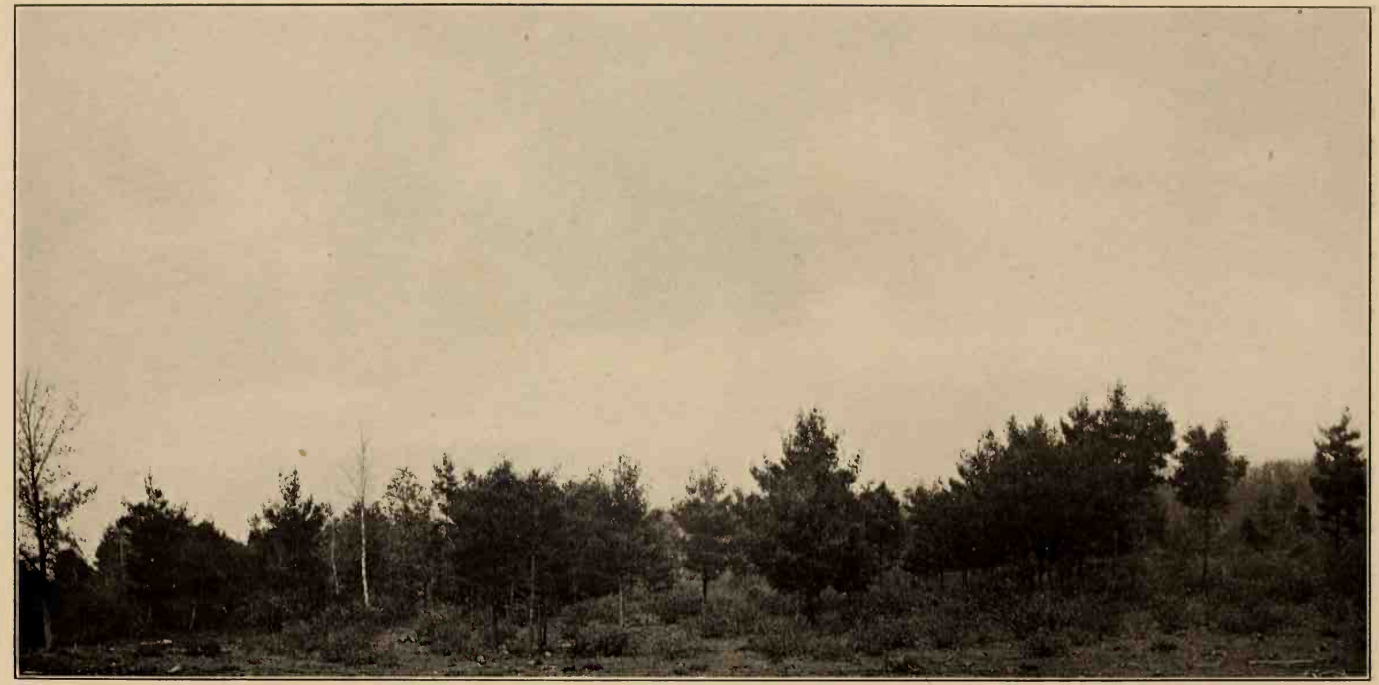

FIG. 6.
The selection method of cutting as applied to an old field type of pine and oak. Five years ago the tract was logged to a diameter limit of about 6 inches. R. I.

cutting admits sufficient light, heat and circulation of air to start enough young seedlings to supplement the sprout reproduction, the remainder of the stand is cut clear. The average stand of hardwoods in this State yields 30 to 40 cords per acre at age 60 years, so that the seed cutting removes 9 to 12 cords. In some cases instead of making the second cutting a clearing, it is desirable to leave a few trees—not over 15 or 20 to the acre—to grow during a second rotation. These reserves or standards should be chosen from the largest trees of the stand; they should have thrifty crowns and be straight, sound, wind-firm and of valuable species like oak, tulip and ash. Such reserves being isolated leaders of the stand, have the advantage of full sunlight and make a maximum growth, thus providing a supply of heavy high grade timber. The cutting, piling and removing of the poles, ties and cordwood in the seed cutting costs a few cents per cord more than by the old method of general clearing in one cutting, but the additional cost is in the long run a most profitable investment.

THE SELECTION METHOD.

In virgin forest all ages and sizes of trees are distributed. Clearings made by wind and small openings made by the falling of old decayed trees are often indicated by the presence of clumps of even-aged seedlings. Specimens, groups and whole stands are arranged according to the full play of the ecologic factors.

The cutting of the large mature trees and at the same time reserving and protecting the medium-sized and small trees to reach merchantable size in a comparatively short time, is the basic principle of the selection method which is adapted to many aged forest, and which was practiced in a crude way by our ancestors who selected and cut here and there single trees or small patches of the heaviest timber, and drew the logs in winter with oxen, horses and sleds to the neighboring water saw mills which now seem likely to come back into use to a limited extent.

This is an excellent method of cutting small amounts of timber in the home woodlot which serves as a wind-break or a covering to a water-shed. All such cuttings should be made with reference to the protection of young trees, the renewal of the forest by natural seeding and the elimination of undesirable species. On ground favorable to logging, if thrifty wind-firm young white pines and hardwoods 1 to 8 inches in diameter, breast high, are left uncut, they begin to grow rapidly after release from the larger trees and provide another stand of merchantable timber in a few years ready for the saw. The selection method as applied to a large area at any one time involves cutting to a diameter limit and marking the trees to be cut. The amount of extra cost of lumbering by this method depends upon the site, the type of forest, the plans of the foreman and the intelligence of the logging crew.

Uneven aged pine-oak stands have been handled in such a way that 30 years after the portable steam mill one finds only a growth of birches, poplars, scrub oaks and other stunted hardwoods with perhaps a very sparse understory of little white pines. This condition is the result of destructive lumbering in which every tree of timber size is sawed and the smaller trees cut into cordwood or broken down in logging.

SCATTERED SEED TREE METHOD.

Mature stands of white pine are cut to advantage after the scattered seed tree method by which 3 to 5 pines, 6 to 12 inches in diameter, and large enough to bear cones are left on each acre to furnish seed. Crooked, knotty trees are just as good as any for this purpose, provided they have thrifty crowns. A light surface burning just before a seed year clears the ground of litter and promotes the germination of pine seed. Sprouts and thick mattings of leaves often retard the reproduction, but even under these adverse conditions the little pines will slowly come into the hardwoods and eventually over-top them.

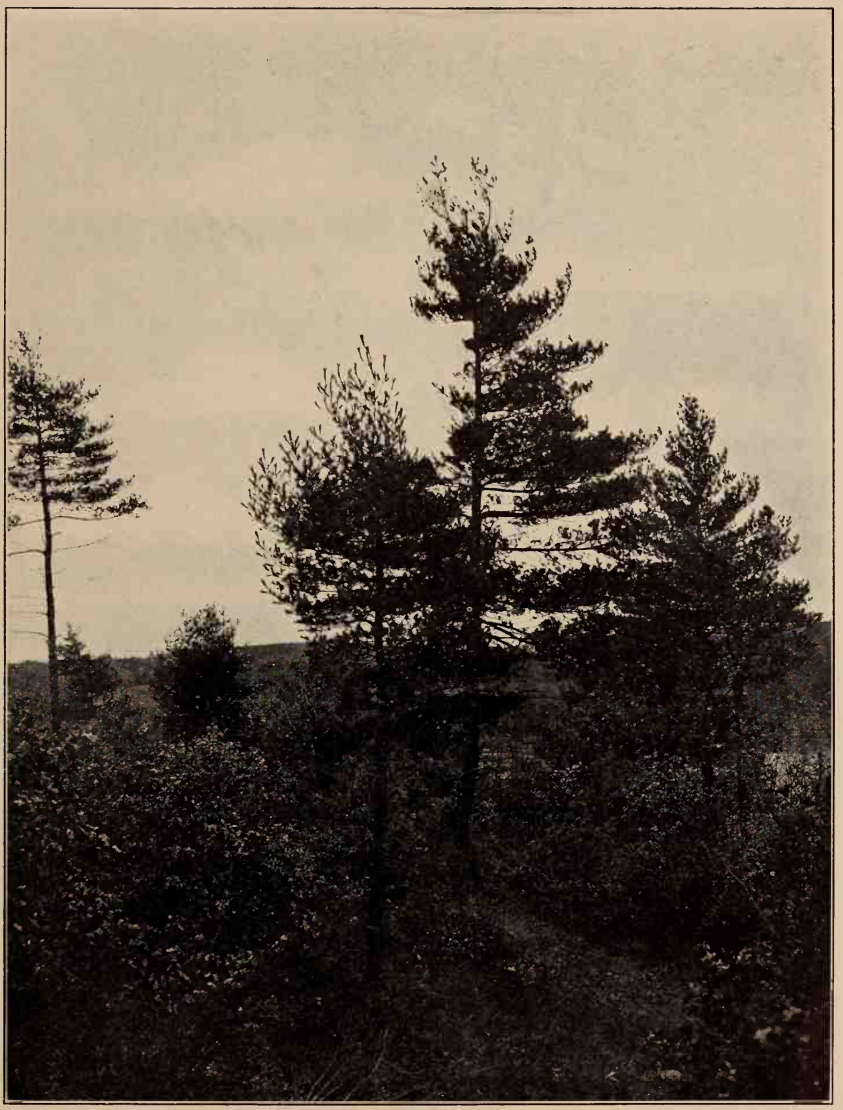

FIG. 7.

Scattered seed trees of White Pine, 6 to 12 inches in diameter, left on a woodlot logged 6 years ago. There is now on the ground a good reproduction of pine seedlings. R. I.

FIG. 8.

Clear Cutting of Timber.

50-year stand of mixed hardwoods—chestnut predominant. The slash and standing small trees are being cut for cordwood. Glocester, R. I.

CLEAR CUTTING OF TIMBER.

The clear cutting of timber and wood in one operation,—the method now used by the lumbermen of Rhode Island,—is the quickest, cheapest method, and under certain conditions is in accord with the science of forestry. Conditions requiring clear cutting are:

1. Forests on ridges, hill-tops and other exposed sites where there is danger of windfall.

2. Stands of pure chestnut which sprouts well at all ages and demands full sunlight.

3. Stands of mixed hardwoods where the sprout reproduction is quite certain to be satisfactory in amount and distribution.

4. Where it is desirable to clean off certain species and plant better species.

5. Rocky and swampy woodland where lumbering is attended with unusual difficulties.

Clear cutting is also permissible in small lots of one or two acres surrounded by forest which is depended upon to seed over the area with desirable species; also in white pine stands just after a good seed year, or after an abundant growth of pine seedlings 2 to 10 inches tall. The logging is done best when the seedlings are covered with a deep snow. In pine tracts, however, it is always safer to leave some old seed trees, unless natural reproduction is to be supplemented by planting.

LOGGING.

The local woodsmen cut the stumps low, usually in autumn or winter and utilize the full merchantable length; in these particulars they practice conservative lumbering. Personal experience in cutting timber and cordwood taught the writer that in felling trees and cutting skidding trails through the underbrush, it costs but little more to avoid injury to young growth. In felling timber each tree can be thrown where it will do least damage; careless felling of a

large tree may smash down a whole group of pine saplings. It is surprising to see what a large proportion of the promising young growth may be saved from injury by the exercise of just ordinary care and common sense in felling and skidding, although of course considerable destruction of young trees cannot well be avoided.

The sprout hardwood stands of Rhode Island are mostly of even age and therefore, the small trees in such stands are of a suppressed and spindling type. In logging these stands no attention is paid to saving these small trees from injury; and rightly so, because it is usually better to utilize such trees for cordwood than to leave them standing on the woodlot to be blown down by wind. Here again the practice of woodsmen is in accord with forestry.

There is, however, need of a departure from the present course of lumbering in the matter of slash disposal. Large tops and branches should not be left in a condition to smother sprouts and feed forest fires. The small branches should be scattered over the ground or if piled in heaps and winrows, burned. In many towns the market conditions for cordwood of all sizes are so favorable that there is no slash question to solve. Where there is no market for cordwood the slash should be handled as follows:

1. It can be used for charcoal.

2. In pine stands it may be piled in heaps and burned as the logging proceeds when the ground is damp or covered with snow; otherwise, the burning is deferred until wet weather. As the trees are felled, convenient places are selected for burning the brush. Fires are started while the trees are trimmed and the branches and tops are thrown on the nearest fire. Experienced men at this work clear the ground and thus make the skidding easier. A sufficient force of men is always present to prevent fire from getting beyond control.

3. In stands of old hardwoods the tops are too heavy to pile for burning; such tops should be lopped by the choppers so that close contact with the ground may hasten decay and enrich the soil.

WASTE IN MILLING.

The amount of waste in local sawmill practice varies with the competence of the different lumbermen and operatives. Waste of lumber appears in many forms, such as unsuitable dimensions, uneven thickness, lack of grading, careless piling, sawing of a species of wood for uses to which it is not best adapted, disregard of the relative value of different products from the same species, ripping the timber into sawdust by sawing thin boards with a circular saw cutting a quarter-inch kerf, sawing clear logs into plank, cutting all the seed white pine in a woodlot, setting the woods on fire with sparks from the sawmill and so forth.

VALUE OF STUMPAGE.

The lumberman is entitled to a fair profit on his investment in stumpage and lumbering, but what is a fair profit, and what is the value of standing timber? Assume a woodlot to be 4½ miles from market; the daily wages of 2-horse team and driver, $5; the daily haul, two loads of lumber of 1,000 board feet each; the cost of hauling is then $2.50 per thousand feet.

Cost of lumbering per thousand board feet:

Cutting	$1 25
Skidding	1 25
Sawing	2 50
Piling	1 00

This makes the total cost of lumbering, including hauling, $8.50; allowing 6% interest for one year on this investment makes the cost $9.01. Frothingham, an authority on lumbering, defines the stumpage value of standing timber to be the market value of the finished product, less the cost of production and a reasonable profit. Then, in the case of lumber production, the stumpage value of timber is the market value of the lumber, less the total cost of lumbering and a reasonable profit on the investment in stumpage and lumbering,

including hauling to market. This definition is expressed by the formula:

S equals $\frac{M}{1. Op}$ minus C, in which S represents stumpage value; M, market value; C, cost of lumbering; and P, rate of profit.

Let the market value of the lumber on this woodlot average $20 per thousand board feet; the lumberman's rate of profit on the investment in stumpage and lumbering 20%; then the stumpage value is:

S equals 5/6 of 20 minus 9.01, or $7.66 per thousand feet. By adding the stumpage value to the cost of lumbering and subtracting the sum from the market value, the lumberman's profit of 20%, or $3.33 per thousand feet, is obtained.

Again, allow the lumberman on his investment 25%, which is considered a good fat profit; then S equals 4/5 of 20 minus 9.01, or $6.99 per thousand feet for stumpage or standing timber; and $4.00 per thousand feet profit. On this basis a woodlot containing one million feet of lumber would have a stumpage value of $6,990, and afford the lumberman a profit of $4,000, plus any profit secured from cordwood. By the use of this formula any forest owner may figure the value of his standing timber.

TIMBER ESTIMATING.

Methods of estimating timber vary with the locality, the value of the timber, and the purpose of the estimate. Many woodsmen can tell near enough for practical purposes, whether a tract will cut ten thousand, fifteen thousand, or forty thousand feet to the acre. An old lumberman by merely walking through a lot of timber will often give a lump estimate that is very close for the whole lot. But for one lumberman who can really give a close and reliable estimate by glancing over the timber, there are many others who only think they can. Two woodsmen will often give the most widely variant and erroneous estimates of a woodlot in this way. In valuable timber,

wild guesses and rough estimates are giving way to the more accurate methods of timber estimating used in forestry.

Although timber yields little or no annual income during its long period of growth, it is now taxed by the same method as houses and cultivated land yielding rent. Under this system of taxation, the amount of taxes with compound interest, paid on merchantable timber often exceeds the price paid for said timber. Since many farmers and others, after paying such taxes for generations, have finally sold their timber for ridiculously low prices, it may not be amiss to indicate here, one or two ways in which the forest warden and forest owner may get some notion of the amount of standing timber in a woodlot.

For lots of 100 acres or less, and of fairly even type, there are several simple ways of timber estimating which give reliable results and which may be used by any person. One way is this:

1. Count the timber trees within a circle of 59 feet radius; this circle contains one-quarter acre.

2. Select one of these trees as a sample tree, having as nearly as one can estimate, the average diameter and height.

3. Fell the tree, and saw it into convenient log lengths.

4. Measure the top diameter inside the bark of each log, with a log rule giving the contents in board feet of edged inch boards in logs.

5. Multiply the number of board feet in the average sample tree by 4 times the number of trees in the quarter-acre plot, to obtain the yield per acre in that part of the stand.

Example: In a stand of mixed hardwoods, suppose the average sample tree is 14 inches in diameter, breast high, and cuts two 12-foot logs of 12 and 9 inches top diameter, respectively. The Maine Log Rule gives the contents of the butt log 78 feet, of the 2nd log 39 feet, making the tree cut 117 board feet. Number of trees in quarter acre, 15; 117 multiplied by 60 equals, 7,020—the yield in feet per acre.

By selecting 8 or 10 such quarter-acre plots in different parts of the woodlot, and applying this method to each plot, the average yield per acre may be found. The degree of accuracy of the method depends upon experience and good judgment in selecting the sample trees and the plots. Allowance for rot and other defects in the stand must be made.

A second method more accurate than the first and requiring no cutting of timber, and especially adapted to small lots of pine, hemlock, and spruce, is as follows: Caliper every tree in the woodlot, down to 6 inches, tallying their number and diameter at breast height. Obtain the average height of the stand by measuring several fallen trees, or by means of a measuring tape and any instrument that measures angles. Having thus, by a few hours of light work, measured the woodlot, the workman may easily obtain the total yield in board feet from Volume Tables which give the contents of trees by diameter and height classes. If the stand consists of uneven aged trees, like old pines scattered among a younger growth, it is necessary to divide the trees into two classes, tallying the diameter and height of each class.

In using log rules and volume tables it should be understood that they are not designed to be very accurate as applied to any single log or tree; they are compiled from the average of a large number of measurements, and are accurate for a number of trees, or a pile of,—say 20 or more—logs

A dozen different methods of estimating are used in forestry, but the estimation of timber is properly the work of a forester, and work which requires the skillful use of forest instruments and mathematical formulas. Any further discussion of the subject belongs to a treatise on Forest mensuration and not to a pamphlet of this kind.

(The Maine log rule may be purchased for a small sum from V. Fabian, Milo, Maine. Volume tables with directions how to use, may be obtained from the Forest Service, Washington, D. C. All kinds of instruments used in the practice of forestry can be pur-

chased from Keuffel and Esser Company, New York City. Books: The Woodsman's Handbook, Graves; Measuring the Forest Crop, Mlodziansky; Cubage et Estimation des Bois, Frochot.)

A WORKING PLAN.

A forester's working plan is a written statement outlining the business policy of handling a forest property for the long run. For the ordinary woodlot it usually embraces such topics as forest description, wishes of the owner, market conditions, protection from injurious agencies, utilization of products, provisions for natural reproduction, cost of lumbering, and rules for cutting. A complete plan for a large tract also includes a division of the tract into forest types and working compartments, estimation of present yield of standing timber, planting plans for waste areas, prediction of future yield based on measurements of the growth rate, and financial returns which take into account on the one side the value of the timber and wood, and on the other, the expenses of taxes, interest and management. In certain parts of the country woodsmen now work according to a forester's plan.

THE COST.

Forestry cannot be practiced without cost; but practical forestry is based on sound business principles, and it involves no present expenditure not warranted by the future returns. The investment may be in the form of planting, thinning, protection, supervision, increased cost of logging, seed trees, and small timber which might be utilized at once. The difference in cost between conservative lumbering and ordinary lumbering varies with many different conditions. The cost of disposal of slash depends on the kind of timber, the amount of young growth to be preserved, and the skill of laborers. The average cost in pine lots is about 25 cents per thousand feet of lumber cut. One authority on lumbering gives the extra cost of work in the woods by forestry methods over other methods, from 25

cents to $1.00 per thousand board feet; the cost of reproduction, including planting and seed trees, $2.00 to $10.00 per acre; the annual cost of protection and supervision, 2 to 10 cents per acre.

The returns from forestry are too obvious for discussion. The beauty and glory of the earth as the home of man depends upon the forest. It is the business of forestry so to develop and perpetuate the forest that it shall serve forever in the highest degree the manifold interests of humanity.